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## APPARATUS FOR HANDLING CYLINDRIC OBJECTS

**State of the Art**

The invention concerns an apparatus for handling cylindric or ring-shaped items,  
5 where the apparatus includes a gripping means arranged to grip around the cylindric periphery of the items.

A prior art apparatus is provided with a gripping means adapted to grip around the cylindric periphery of the items, rotate them about a substantially horizontal axis and  
10 deposit them in a vertical stack. This prior art apparatus is mounted in front of a specially adapted forklift truck, instead of lifting forks, and consists of a rotatable suspension provided on the lift tower of the forklift truck. The suspension may be elevated and lowered on the forklift truck by means of integrated lifting/lowering functions on the truck. The suspension may rotate the gripping means about a  
15 horizontal axis which is substantially extending through and in extension of the forklift truck, as the gripping means extends to both sides of the truck in the initial position. The gripping means is C-shaped, as the opening of the C faces downwards in the position where the gripping means is to grip around the items which are arrayed in a row, the C being divided in to different sized parts, the larger of which making the  
20 gripping movement. The apparatus is adapted to handle lorry tyres which due to their weight are cumbersome to handle, and which according to current rules are no longer to be lifted manually above shoulder height.

A row of tyres standing leaning onto a wall or a stand may be gripped around their  
25 periphery by the prior art apparatus, elevated and rotated into a position where they may be deposited as a vertical stack. Due to its geometrical configuration, the apparatus has a short reach, necessitating access to both sides of the platform of a vehicle if e.g. two rows of tyres are to be stacked side by side on the platform. Furthermore, at loading as well as unloading a vertical stack it is necessary with extra  
30 room beside the stack in order to provide room for opening and withdrawing the larger part of the C-shaped gripping means extending around the stack to the opposite side of the forklift truck.

### Explanation of the Invention

The apparatus according to the invention is peculiar in that it includes a base part arranged for mounting on the load bearing members of a forklift truck in such a way that the base part extends substantially horizontally out from the forklift truck, where  
5 at the free end of the base part there is suspended a gripping part including an elongated frame at a point between the free ends of the frame so that the frame may be pivoted about a horizontal axis extending transversely to the base part by means of displacing means, from a first, largely horizontal, position substantially in parallel with the base part to a second, largely vertical, position largely perpendicularly thereto, and that the gripping means is arranged on the frame and consists of a pair of mutually pivoting jaw members that extend along and from the lower side of the frame  
10 when the frame is in the first position.

The apparatus according to the invention may thus be retrofitted to existing forklift trucks on the load bearing members of the truck, usually lifting forks, without requiring any modifications in the construction of the lifting tower of the forklift truck. Retrofitting is thus simpler than by the prior art. The apparatus operates in that the forklift truck moves the apparatus in open condition, i.e. with the jaw members apart, and in horizontal position across the row of cylindric or ring-shaped items, e.g.  
15 tyres for vehicles, approaching from one end of the row. The row of items is gripped by the jaw members, lifted by the existing mechanism in the tower of the forklift truck, and rotated about a horizontal axis transversely of the longitudinal axis of the base part. Then the stack may be deposited on a platform or in a place for storage.  
20 When depositing, the jaw members, which are the same size and provided symmetrically about a centre plane, are only to open slightly in order to release the now formed stack. By using the apparatus according to the invention is furthermore achieved that rotation of the stack occurs in a vertical plane in continuation of the forklift truck, i.e. the stack is pivoted about an axis transversely of this vertical plane and thus transversely of the longitudinal axis of the truck. As the base part of the apparatus extends horizontally out from the tower of the forklift truck, a greater reach  
25 for the apparatus is attained when loading and unloading e.g. a platform of a vehicle, and it is therefore possible to load lorry tyres in two rows on the platform, even if the platform is only accessible from one side. Furthermore, the geometry of the gripping means that stacks may be disposed closer to each other. If the tyres are hanged on a  
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horizontal cantilever beam, the apparatus may simply grip around a row of tyres, pull them off the beam and deposit the tyres as a vertical stack, as the beam will provide vertical parallel disposition of the tyres. By the invention it is possible to stack heavy items over shoulder level and thereby utilise the capacity of e.g. lorries optimally.

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Other cylindric items may be handled by the apparatus, e.g. paper rolls and oil barrels.

According to an aspect of the invention, at each of the two free ends of the frame there may be provided an adjusting member projecting in the same direction and to the same side of the frame as the jaw members, where the adjusting members may be moved independently towards and away from each other. In initial position, the two adjusting members at the ends of the frame may be displaced away from each other as far as possible. Then the apparatus is lowered down over the tyres so that the adjusting member farthest from the truck goes down between two tyres, possibly between the last tyre and the adjacent stand or wall. Then the two adjusting members are drawn towards each other until the tyres are in contact with each other. In their compressed position, the items (tyres) are clamped by the jaw members which pinch opposed sides of the periphery of the items, which as a whole largely constitute a kind of cylinder. Then the items may be lifted up by means of the common lifting function on the forklift truck, and the gripping part with the items are pivoted so that they constitute a vertical stack, after which the stack can be deposited on the place of deposition in a normal way, as the jaw members are opened at last. Due to the compressing of the row of items to the point of mutual contact before being gripped by the jaw members, no mutual displacing of the items appears at the opening of the jaw members, and manual adjustment afterwards is made superfluous, as well as optimal utilisation of storage room or transport surface is enabled. By this embodiment of the invention the need for manpower when handling large vehicle tyres may be reduced to one man, namely the forklift truck driver, where 2-3 people were needed by the prior art.

30 In order to achieve a reliable and stable function of the adjusting members, at least one adjusting member may be mounted in a slide which is displaceably seated in the longitudinal direction of the frame, where at least one displacing means, e.g. a hydraulic cylinder, is arranged to displace the slide in relation to the frame.

In a further aspect of the invention, the adjusting member mounted in the slide is suspended pivotably about a largely horizontal axis by means of at least one displacing means, so that the adjusting member may be moved from a position where it is extending transversely to the frame to a position where it is situated in continuation of or parallel with the frame. The suspension of the slide may thus be utilised for achieving greater mobility of the adjusting members so that they may be pivoted entirely free of the area located under the frame, which may be an advantage when the apparatus is to be disposed across a row of items, as the truck driver then may have free view under the frame without having his view blocked by the adjusting members.

In order to remove the adjusting members from the region at the ends of the frame and thus to avoid the adjusting members interfering with the handling of the items and depositing the items, the apparatus may be designed so that the frame has structural parts consisting of two U-shaped side members disposed with their open sides towards each other, and that the slides are carried in the side members so that when the adjusting members have been pivoted into position in continuation of the frame, the slides may be drawn so far in between the side members that the adjusting members do not project beyond the outer dimensions of the frame.

In a further aspect of the invention, the displacing means and functions of the apparatus are connected to a central control unit adapted to be retrofitted in a forklift truck, where a joystick for operating the apparatus forms part of the control unit.

The term "displacing means" in the present description and claims means any kind of force exerting displacing means, whether electric actuators or hydraulic cylinders.

### **The Drawing**

Example embodiments of the invention will now be described with reference to the drawing, where:

Fig. 1 shows a first embodiment of the apparatus according to the invention in perspective view obliquely from behind and with the gripping part pivoted into vertical position;

- Fig. 2 shows the apparatus of Fig. 1 with the gripping part in horizontal position, where the jaw members are gripping around a row of lorry tyres;
- Fig. 3 is a longitudinal section through the first embodiment of the apparatus according to the invention in the same position as in Fig. 2 but without any 5 tyres;
- Fig. 4 is a section according to the line IV-IV on Fig. 3;
- Fig. 5 is a perspective view of the section on Fig. 4;
- Figs. 6 and 7 are details in perspective view of the front and rear slide, respectively, with the adjusting members in the positions shown on Fig. 3; and
- 10 Fig. 8 shows a second embodiment of the apparatus according to the invention in perspective view.

### Description of Example Embodiments

- In the embodiments shown on the drawing, the apparatus according to the invention is composed of a base part 1 and gripping part 2 that is pivotable in relation thereto. The 15 base part 1 is designed as a substantially flat frame structure comprising two hollow sections 3 that may receive lifting forks of a not shown forklift truck, as the forks are inserted into the open ends of the sections 3. Flanges 4 are welded on the sections 3 at both sides at the end of the base part 1 facing away from the forklift truck during use.
- The flanges 4 are provided with bearings for a through-going journal 5 that carries the 20 gripping part 2. The structural parts of the gripping part 2 are constituted by two U-sections 6 on which are welded other flanges 6a for forming connection to the journal 5.
- 25 For pivoting the gripping part 2 in relation to the base part 1, displacing means in the form of hydraulic cylinders 7 are provided, one at each side, so that the gripping part 2 may be pivoted at least 90° relative to the base part 1. The cylinders 7 may alternatively be provided as electrically powered actuators if e.g. the truck is driven by electric power.

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The U-shaped side members 6 are positioned mutually so that their concave sides face the centre of the frame, which constitutes a kind of backbone of the gripping part 2. For the sake of clarity, a number of required hydraulic hoses, valves, sensors etc are omitted on the drawing. As force transmitting elements there are provided two pairs of

yokes 8, see Figs. 2, 4 and 5.

On the yokes 8 are pivotably suspended two pairs of jaw elements 9 which may pivot about journals 10 by means of hydraulic cylinders 11. At each side of the gripping part 5 2, the jaw elements 9 are mutually connected in longitudinal direction of the gripping part 2 by rods 12 and a through-going holding means 13 which is provided by welding as a hollow profiled member. Together with the rods 12 and the holding means 13, the jaw elements 9 form a gripping means that may seize around the periphery of a row of ring-shaped items 21 which in combination form a largely cylindric body.

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At each of the free ends of the frame and thereby of the side members 6, a front and a rear adjusting member 14 and 15, respectively, are provided. The adjusting members 14, 15 are here embodied as plate pieces, but other embodiments may be envisaged, e.g. as finger-like members. In order to press together a row of ring-shaped items, e.g. 15 lorry tyres, into a stack without gaps between the items, the adjusting members 14, 15 are made so that they may be displaced by translation as well as pivoted in relation to the side members 6. In the shown embodiment, this is effected by mounting each adjusting member in a separate displaceable slide 16 which, as shown on Figs. 6 and 7, are built up as a frame structure. The slides 16 are carried in the side members 6 by 20 means of not shown slide guides, and the slides 16 may be displaced relative to the side members 6 by means of the cylinders 17 mounted on the frame. The cylinders 17, or their piston rods, may best be seen on Figs. 1 and Figs. 3. In each slide 16, the adjusting members 14, 15 are pivotably suspended by journals 18, and they may pivot by the action of hydraulic cylinders 19. By means of the cylinders 17 and 19, it is 25 possible to let each adjusting member 14, 15 be in a position where it points down, approximately perpendicularly relative to the side members 6, and to be moved to a position parallel with, or approximately parallel with, the side members 6 and withdrawn so that the adjusting member 14, 15 is disposed within the outer dimensions of the frame, see Fig. 2 for the latter case.

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In this embodiment, the rear adjusting member 15 is designed a little differently from the front adjusting member 14, in that the adjusting member 15 is provided with a cutout 20 which will improve the forklift truck driver's view under the member 15 when pivoted to the downwards directed position.

In the preferred embodiment, the apparatus according to the invention is connected to the hydraulic system of the associated forklift truck and is controlled by a valve block inside the driver's cab. It is preferred to perform control with a joystick and so that all the movements of the apparatus may be controlled with one hand and one operating handle. The control system is not shown in detail as it is assumed it will be within the ability of the skilled in the art to make such a control system.

The apparatus may function as follows: A number of lorry tyres 21, or other ring-shaped items, stand on a base arrayed in a row side by side, where the row is leaning on a wall or a stand at one end. While mounted on a forklift truck, the apparatus is driven to the row, and the apparatus is in initial position as shown on Fig. 3, i.e. with the front adjusting member 14 downwards directed position and the rear adjusting member 15 in wholly or partly drawn up position, while the jaw members 9, 12, 13 are in open position and drawn apart. Then the gripping part 2 of the apparatus is lifted in over the row from the free end of the row and lowered down on the row, so that the front adjusting member 14 is engaged between and separates two tyres, alternatively between the last tyre and the support on which the tyres are leaning. Then the adjusting member 14 is pulled towards the base part 1 and the forklift truck by means of the cylinder 17, so that the tyres in the row are raised between the jaw members 9, 12, 13. Then the rear adjusting member 15 is pivoted to the downwards position and is pulled inwards against the row of tyres, compressing the tyres until they form a continuous stack, using both the cylinder 19 and the cylinder 17. Then the cylinders 11 are activated, pivoting the jaw elements 9 against each other so that the gripping means performs its gripping function, and the holding means 13 squeeze around the tyres 21 slightly below their centre so that they may be securely lifted. Then both adjusting means 14, 15 are pivoted up in alignment with the side members 6 and retracted flush with the members 6, cf. Fig. 2, so that they do not interfere at the subsequent operations.

The entire row of tyres 21 may now be lifted up and pivoted to vertical position by the cylinders 7, cf. Fig. 1 (showing a second and not relevant position of the adjusting members 14, 15). The forklift truck may then drive to another place where the tyres are to be delivered, e.g. a pallet or a vehicle platform. As the tyres 21 are now stacked and arranged so that they flush with each other and without interspaces, it is possible

to dispose this stack and the succeeding stacks without need for adjusting the stacks afterwards.

5       The apparatus according to the invention also has the advantage that it may be applied on existing forklift trucks, as the hydraulic system of the forklift truck itself may be used as source of power for manoeuvring the apparatus.

10      The second embodiment of the apparatus according to the invention is shown on Fig. 8 and is constructed in principle as the first embodiment of the apparatus, but differs from it with regard to some details. The changes are made primarily in order to improve the view through the apparatus. The journal designated 5 in the first embodiment has been removed, and flanges 4a are moved in over the side members 26 for forming two independent journalled suspensions 25 in other flanges 26a for the gripping part 2a (which corresponds to gripping part 2 in first embodiment). The point of connection of cylinders 7a on gripping part 2a is moved. Furthermore, the transverse reinforcing girder between the two hollow sections 3a has been removed. Instead, reinforcement is achieved by connecting an eye 24 at each section 3a with not shown adjustable brace rods to overlying points on the tower of the forklift truck (not shown). The driver of the forklift truck on which the apparatus is mounted may thereby better see the items to be stacked through the open structure of the apparatus during the handling operation. Furthermore, the gripping means is modified, as holding means 13 are substituted by rods 12a so that the construction is simplified and made lighter.

25      Further embodiments of the invention are possible. Among others, it is possible to replace the slides at each end of the frame with another embodiment of the cylinders 17 and 19, as each adjusting member 14, 15 is disposed pivotable on the piston rod end of one or two displacing cylinders that may perform a displacing movement like the cylinder 17, and where there is a further tilting cylinder substituting the cylinder 19. The tilting cylinder is thus mounted on the housing of the displacing cylinder and has its piston rod fastened to another point on the adjusting member 14, 15 so that the adjusting member may pivot by the extension and retraction of the tilting cylinder.

In a third, not shown embodiment, which in principle is designed as one of the two

above embodiments, the apparatus may be simplified and made cheaper by omitting the adjusting members 14, 15 with associated cylinders 17, 19 and the hydraulic system. In this simplified embodiment, it is still possible to seize a row of tyres or other ring-shaped items leaning on each other in a row on a base, lift them up, pivot 5 the row to the position on Fig. 1, and deposit the row as a stack on another base, e.g. a platform on a vehicle. Even though the items cannot be pushed tightly together during the gripping action due the absence of the adjusting members, the long reach of the apparatus provided by the extended base part 1 compared with prior art enables a larger number of tyres or other cylindric items to be stacked far in on a depositing 10 platform, enabling loading e.g. a vehicle platform which is only accessible from one of its sides.